Space Weather Technical Forecast

Issued on Thursday 7 November 2024 at 00:11 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate to High solar activity with further M-flares expected. Chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been High with an impulsive X-class flare observed at 06/1340 UTC from AR3883 in the southeast, peaking at X2.3. There have also been numerous other M-class flares, predominantly from AR3883 and AR3886.

There are currently eight numbered sunspot regions on the visible disc, with the leading edge of a new region beginning to emerge at the east limb. The two most magnetically complex and recently active regions are located in the southeast quadrant. Both regions are large and contain numerous spots, and continue to show slow spot evolution, with westernmost group (AR3883) having a delta spot configuration in its intermediate portion. There is another large spot located in the northwest, however this has been stable and largely inactive. Remaining spot regions are smaller and magnetically simpler, and either stable or in decay.

No Earth directed CMEs (Coronal Mass Ejections) were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as measured at L1 by ACE/DSCOVR were at Slightly Elevated levels for much of the period, between 450-480km/s. However, speeds decreased after 06/1500 UTC toward background levels, now near 400 km/s. Density was below average, and on a slight falling trend. The Interplanetary Magnetic Field (IMF), Bt, was Weak between 2-7nT. The north-south component, Bz, varied weakly, oscillating between positive and negative directions. Phi angle was mostly positive (away from the Sun), with some brief switches to negative (toward the Sun). Geomagnetic Activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background. The associated 24-hour fluence was well below the Active threshold, with 1.91e6 integrated flux observed at 07/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High activity is forecast to continue, with occasional M-class flares expected and a slight chance of isolated X-class flares. These most likely from AR3883 and AR3886.

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Solar Wind / Geomagnetic Activity: A minor HSS enhancement is possible late Day 1 (07 Nov) into Day 2 (08 Nov) from a small equatorial coronal hole, with further possible HSS influence late in period from a larger but southerly located coronal hole.

A CME was observed near the east limb in association with the M3.8 flare from AR3883 on 04 Nov. Although the bulk of the ejecta appears to pass behind Earth's orbit, a faint partial halo of material (mainly shock) appears to pass the Earth-Sun line, meaning that there is an chance of a glancing impact from this feature either late 06 Nov or on 07 Nov. This event currently carries low confidence.

Geomagnetic activity is expected to be generally Quiet through Day 1 (07 Nov), but potentially becoming Unsettled to Active with a slight chance of G1/Minor Storm intervals depending on any potential glancing CME influence. On Days 2-4 (08-10 Nov) activity should be Quiet to Unsettled, with a chance of isolated Active intervals.

Energetic Particles / Solar Radiation: The high energy proton flux at GOES-18 remains at background levels, with only a slight chance of an enhancement above S1/Minor Storm levels. The high energy electron flux is expected to be mainly Background to Moderate, with the associated fluence forecast to persist below Active levels.

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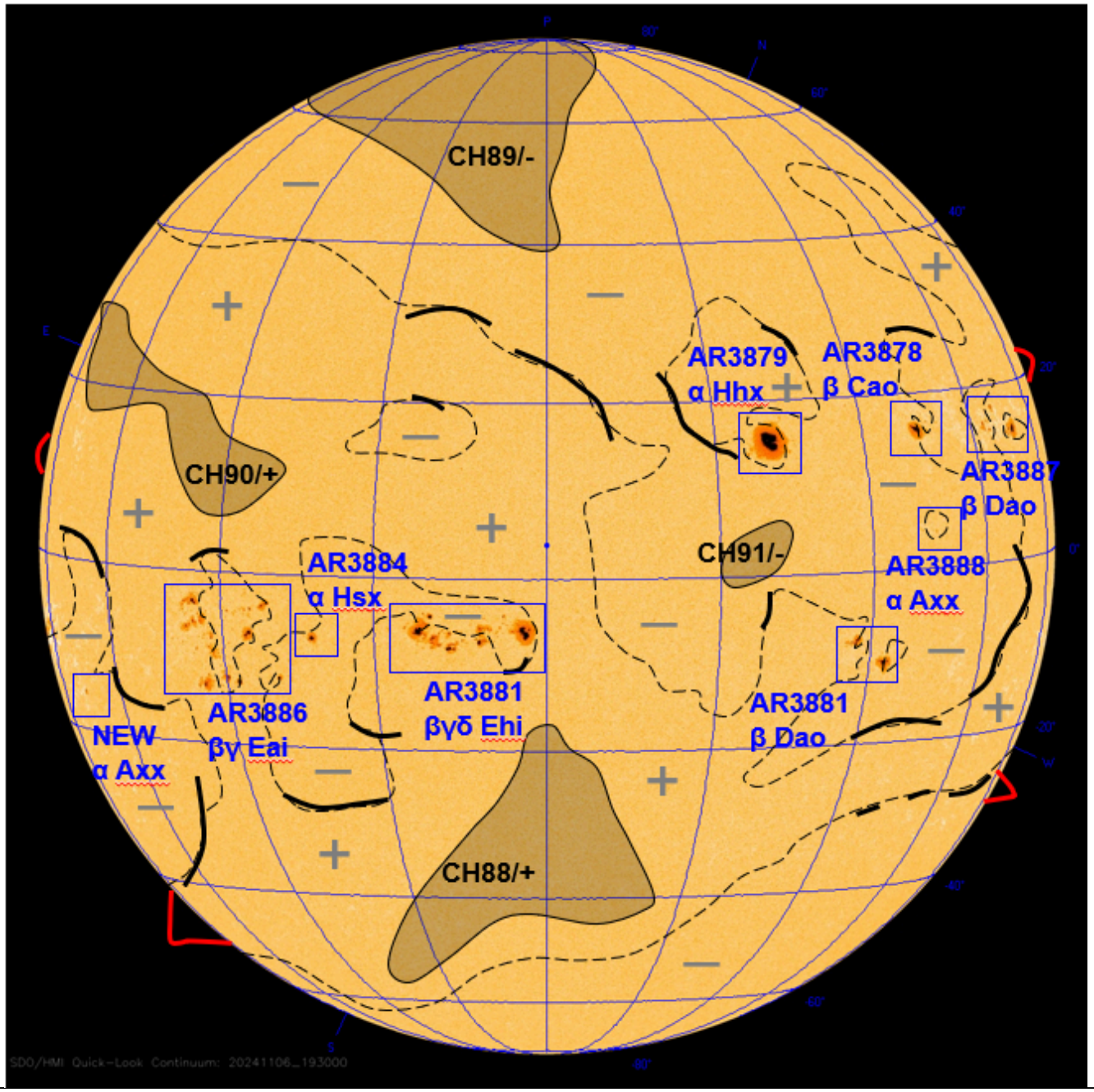
Figure 1: Solar Synoptic Analysis VT 06/1930 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME was observed off the E limb in association with the M3.8 flare from AR3883 at 04/0141UTC, with an associated Type II radio emission of 307km/s. Some data gaps in coronagraph imagery have backfilled since the initial analysis was conducted by MOSWOC. Although the bulk of the ejecta appears to pass behind Earth's orbit, a faint partial halo of material (mainly shock) appears to pass the Earth-Sun line, meaning that there is an increased chance of a glancing impact from this feature during 07 Nov. This event currently carries low confidence.

The near Earth environment was weakly enhanced for much of the period with winds at Slightly Elevated levels, likely as a result of a weak connection to coronal hole CH87/+, or perhaps CH86/+. However, speeds decreased after 06/1500 UTC toward background levels, now near 400 km/s. Recently numbered small coronal hole CH91/-, near centre disc, may give some weak enhancement in solar winds later on day 2 (08 Nov) or day 3 (09 Nov), but as this is a non-recurrent feature confidence is moderate. MOSWOC's ENLIL model shows a more significant enhancement from HSS influence from day 1 (07 Nov), but this appears unreliable, and is more likely to come from CH88/+ toward the end of the period. However, this is again low confidence due to its southerly latitude.

Geomagnetic activity is expected to be generally Quiet through Day 1 (07 Nov), but potentially becoming Unsettled to Active with a slight chance of G1/Minor Storm intervals depending on any potential glancing CME influence. On Days 2-4 (08-10 Nov) activity should be Quiet to Unsettled, with a chance of isolated Active intervals.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	10	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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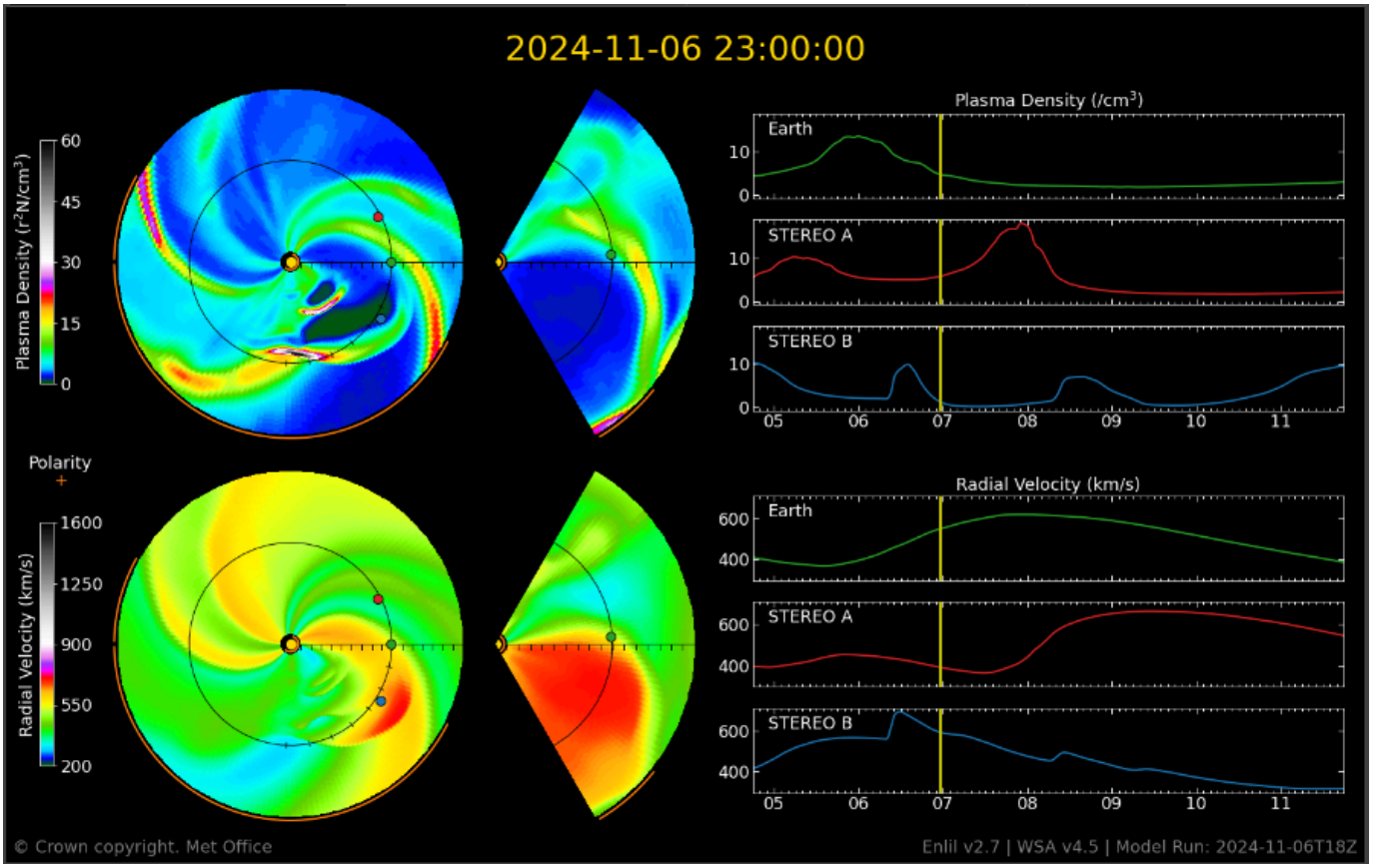
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
2024-11-04 05:39	Partial	AR3883	SE	880	06-07 Nov	Arrival time uncertain. May give glancing impacts.

Figure 2: Enlil shows possible glancing CME early on 07 Nov



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Radio Blackouts - X-Ray Flares

There are currently eight numbered sunspot regions on the visible disc, with the leading edge of a new region beginning to emerge at the east limb. The two most magnetically complex and recently active regions are located in the southeast quadrant. Both regions are large and contain numerous spots, and continue to show slow spot evolution, with westernmost group (AR3883) having a delta spot configuration in its intermediate portion. There is another large spot located in the northwest, however this has been stable and largely inactive. Remaining spot regions are smaller and magnetically simpler, and either stable or in decay.

Moderate or High activity is forecast to continue, with further M-class flares expected and a chance of a further isolated X-class flare, with AR3883 and AR3886 currently the most likely sources.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	Yes	90	90	90	90
Very Active	R3-R5 (X Class)	Yes	25	25	25	25

Figure 3: GOES16/18 X-ray flux over past 24 hours

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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES-18 is at normal background levels following enhancements in the past week. Many of the sunspots that currently occupy the usually more geoeffective western hemisphere are smaller, less complex regions compared to those in the eastern disc. However, a number of regions recently rotated over the western horizon could still pose a small risk of an enhancement at first, and the current most active eastern region will be transiting into the western hemisphere during the period. Therefore, there is a slight chance of S1/Minor Proton Storms or greater during the period should any further proton-rich flares occur.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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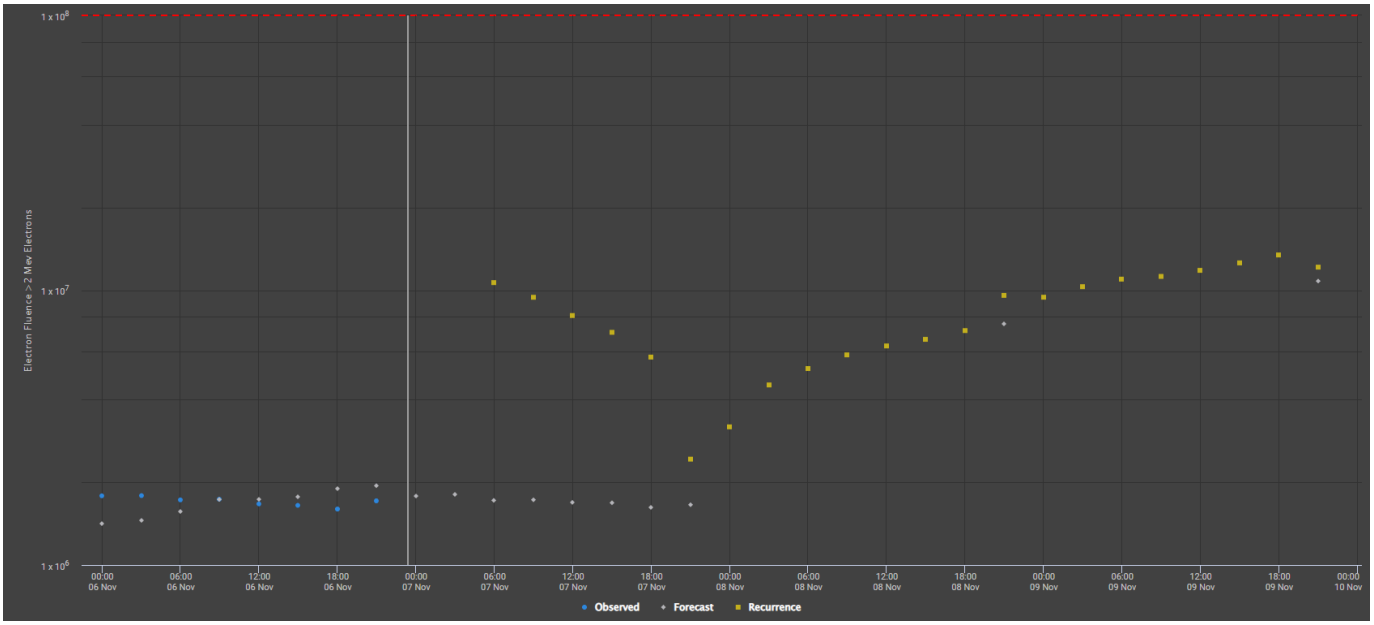
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background and expected to persist mostly at this level, with only brief periods of Moderate enhancement expected. A more significant connection to coronal hole fast winds later in the period may see the electron belts charge up, and electron flux levels rising perhaps towards Moderate levels.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period however, with the MOSWOC REFM output considered reasonable guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	5	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM latest output



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